

How Zynga Created Performance Analytics for Web Games

David Grunwald

Principal Engineer, Zynga



Principal Engineer
Shared Technology Group



Our 56 Million DAU* puts 60 Billion rows of data into our data warehouse every day.

*2012 Q4 Earnings report

Agenda

- What is client performance
- Why we care about performance
- Performance metrics:
 - What's the point of player data
 - Why it's hard
 - What we've done
- How we've matured

Agenda

- What is client performance

What is Performance?

Server Efficiency and Scalability:

What is Performance?

Server Efficiency and Scalability:



What is Performance?

Speed of gratification:

What is Performance?

Speed of gratification:

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What is Performance?

Frame Rate:

What is Performance?

Frame Rate:

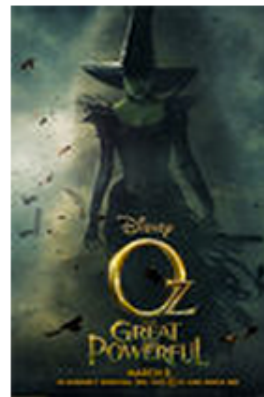


What is Performance?

Fidelity:

What is Performance?

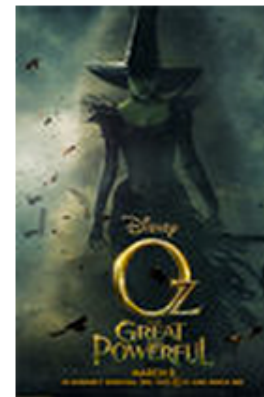
Fidelity:



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REALD 3D



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IMAX 3D

What is Performance?

Responsiveness:

What is Performance?

Responsiveness:



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- What is client performance
- Why we care about performance

Why does Performance Matter?

Hopefully it makes your players happy!



"Yes! It's great! The news helicopter is finally moving. All of my creepy crypts are popping their lids (in unison). My whales are jumping. Thank you very much."

Why does Performance Matter?

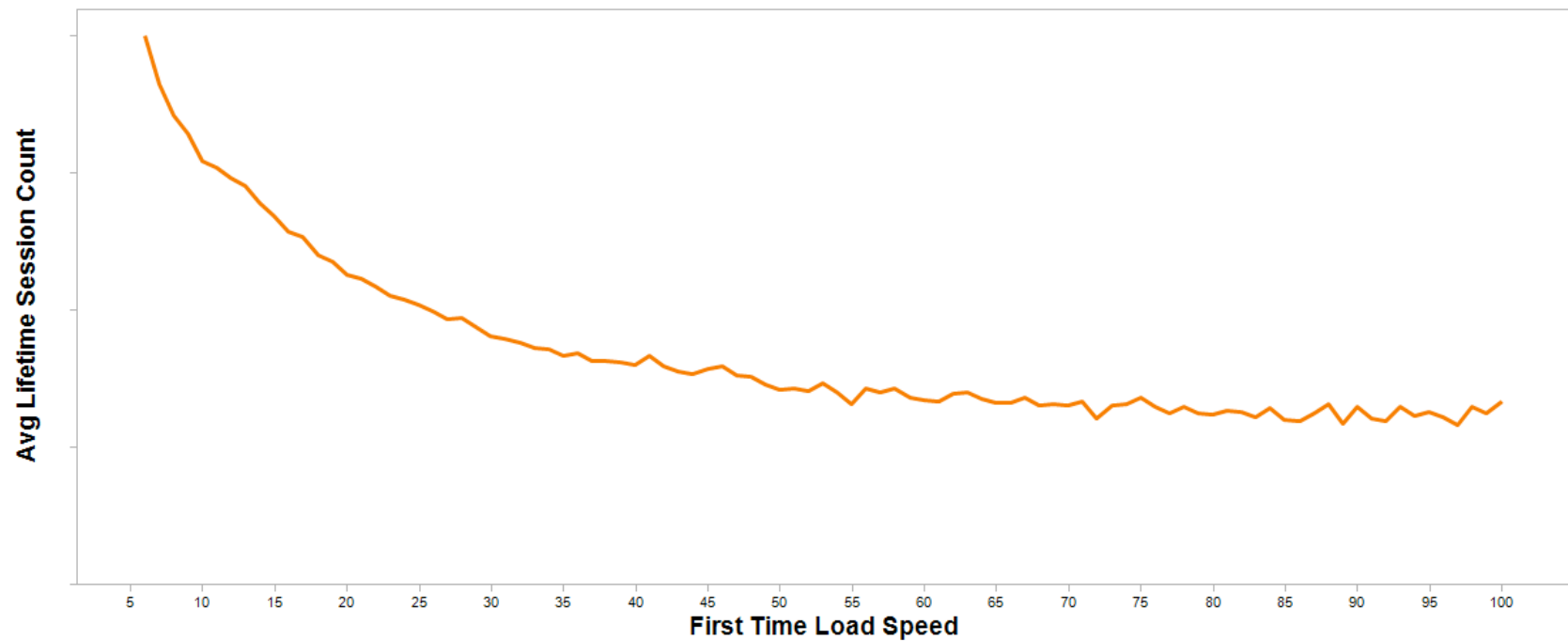
Hopefully it's good for
business



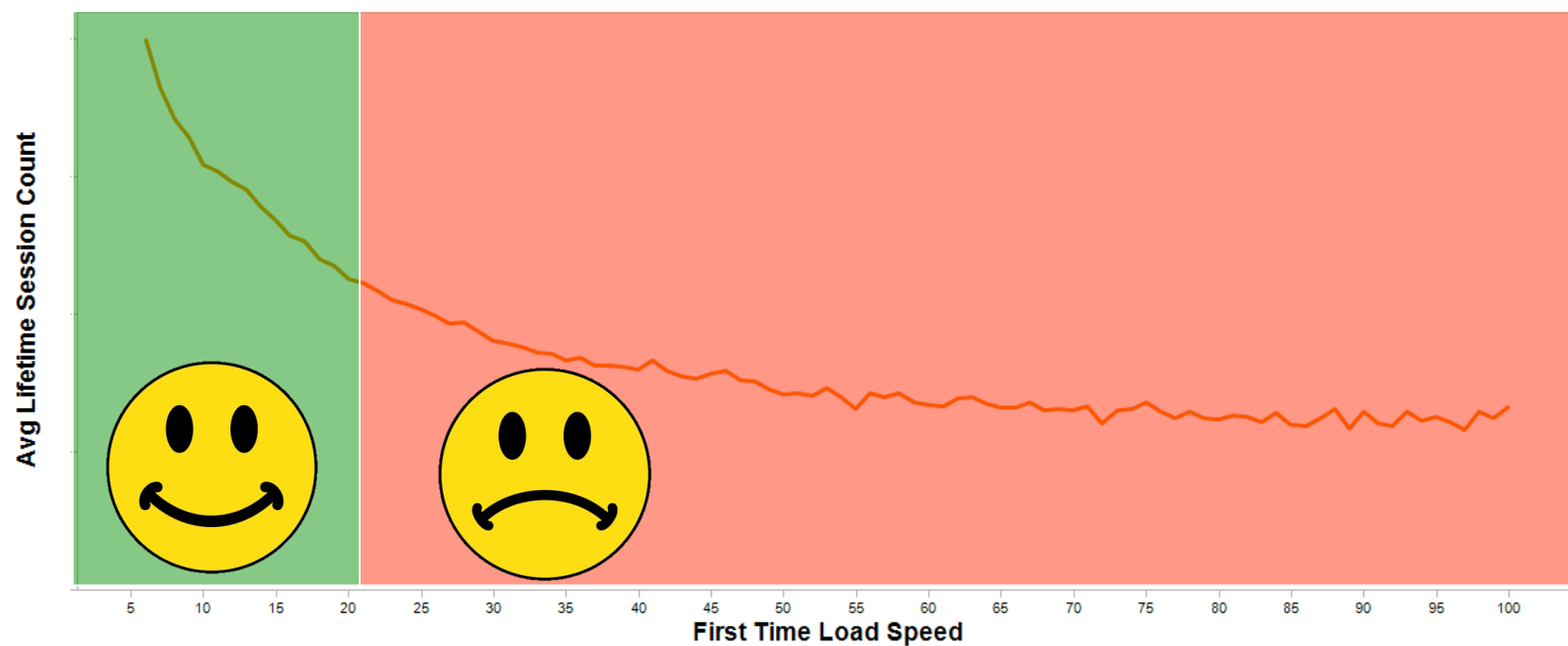
Free to Play Games

- Where's the money?
- It seems appropriate to assume that more people play a game that loads faster, looks better and and is more responsive...

Load Time and Retention



Load Time and Retention



Revenue and Performance



A bone headed hypothesis:

Make performance worse and profits will increase!

A bone headed hypothesis:



Make performance worse and profits will increase!

An accurate hypothesis:

Player behavior determines performance variability more than anything else.

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What's the point of game metrics?

- Understand your game's reality rather than theory.
- Maintain the quality of your live game.*
- Improve the quality of your live game.*

* Quickly, efficiently, and predictably.

Get some top level metrics

- A direct measurement of the player experience
 - Load Time
 - Frame Rate
- Should track the health of the game

Knowing is half the battle

- You must have the data and tools to understand the root cause of any performance issue.



Top level performance metrics are
insufficient for effecting change

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How Engineers work on bugs

1. Reproduce the bug
2. What changed in the code?
3. What changed in the environment?
4. Ask for clarification
5. Ask for reproduction case
6. Give up

Reproduce the bug

- Playing the game had a slower framerate today. Go!
- Um...

The code changes

- We release new versions of the game multiple times a day.
- Often it's a content release.
- Often there is no change.
- Maybe somebody added an N^3 algorithm.

The Environment

- We have lots of active (and changing) A/B experiments going on at all times
- What if there's a new Browser release?
- Sundays are different than Mondays

Clarification?

- Ship new code to get more information
- Build new reporting tools to process said new information
- Sometimes the problem has gone away
- Doesn't inform what has changed

Getting a reproduction

- Players speak a different language than engineers
- Loading a players world into your own account doesn't necessarily reproduce what they were doing

There's one very likely conclusion

- Give up
- Hope nobody notices that nothing got done for a couple days.



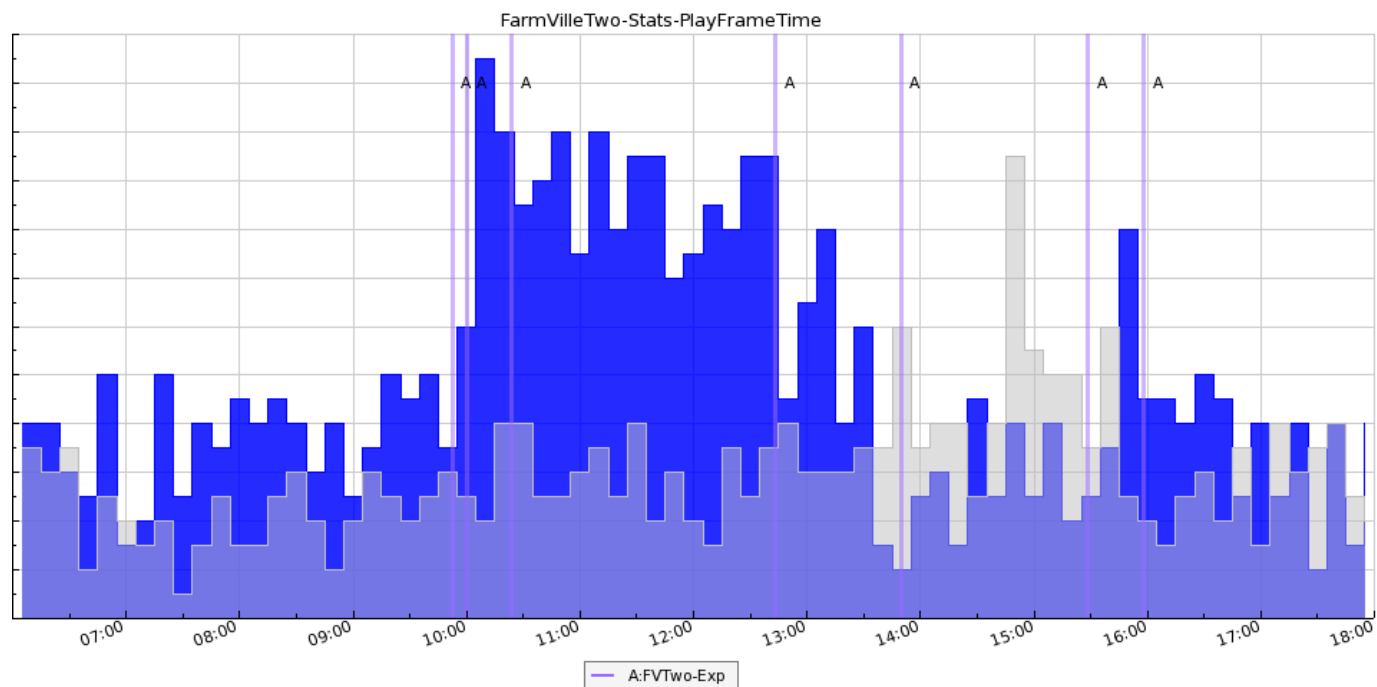
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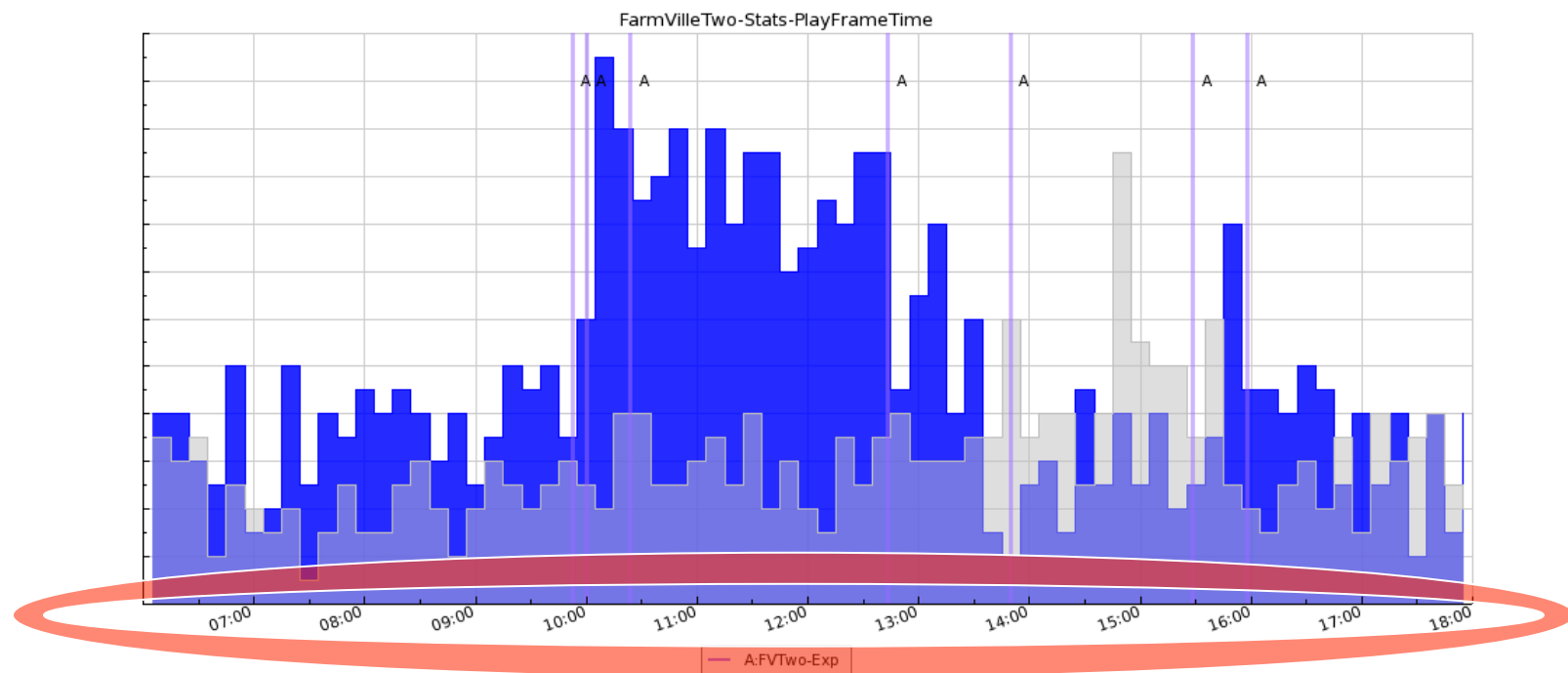
You don't need to give up!

good data, good tools.

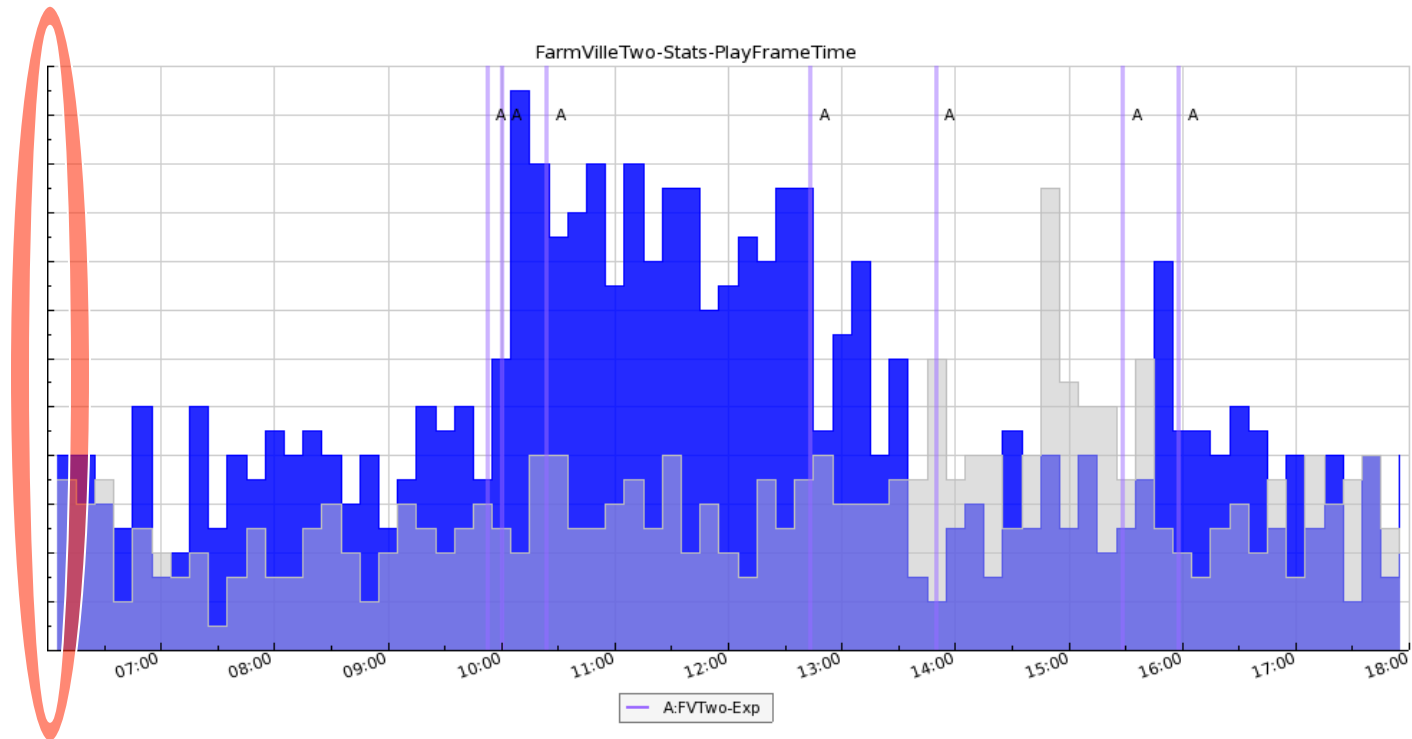
With tools, the correlation is clear



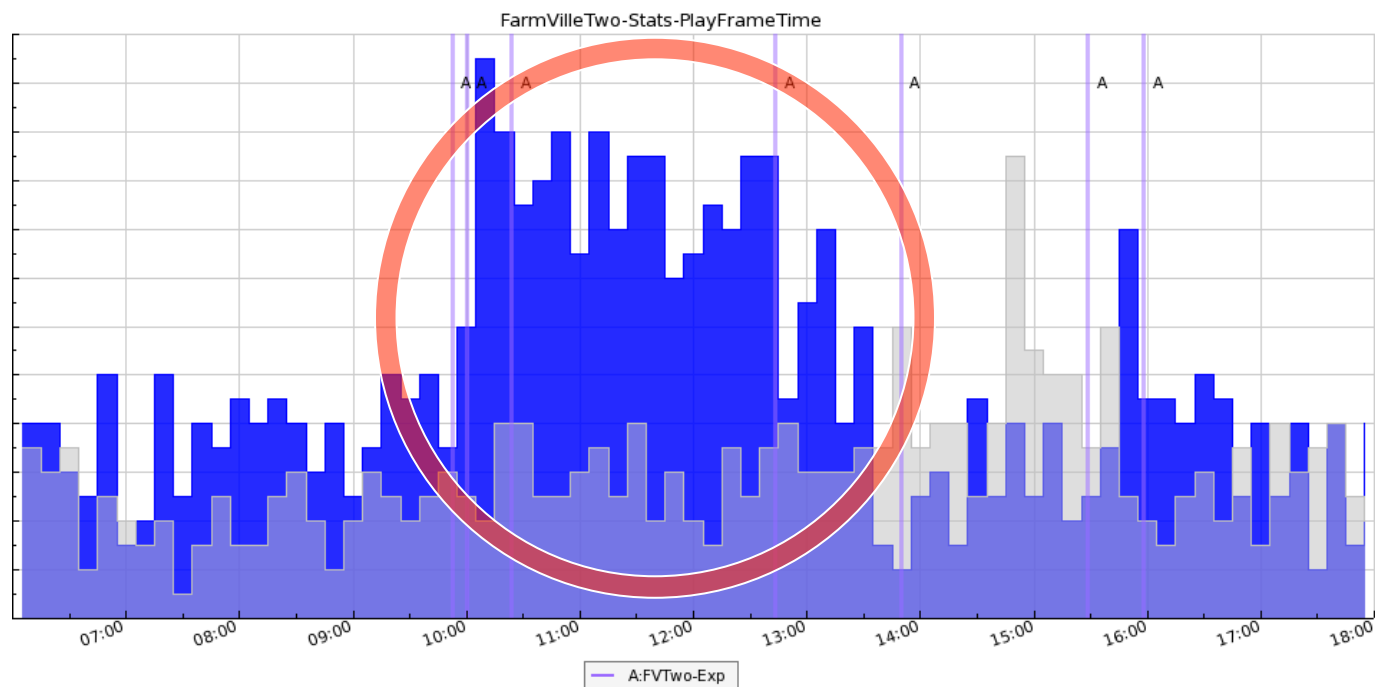
With tools, the correlation is clear



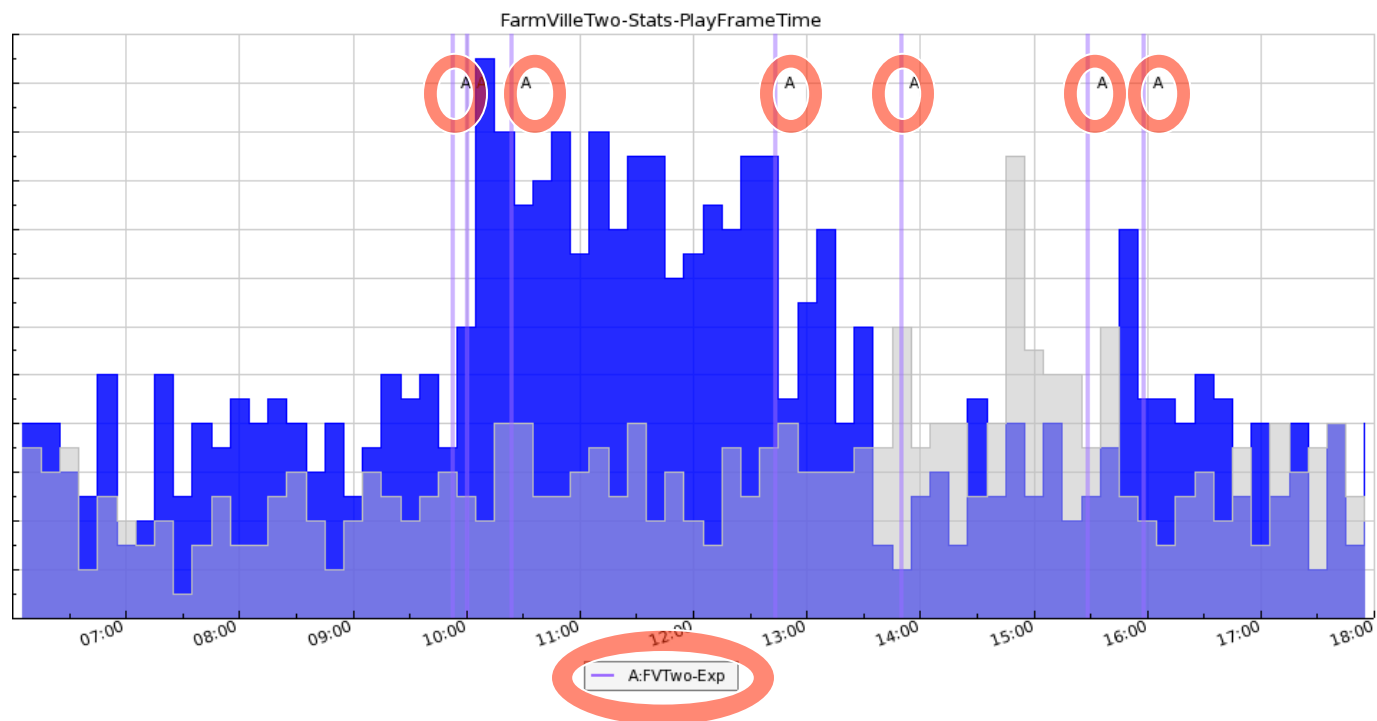
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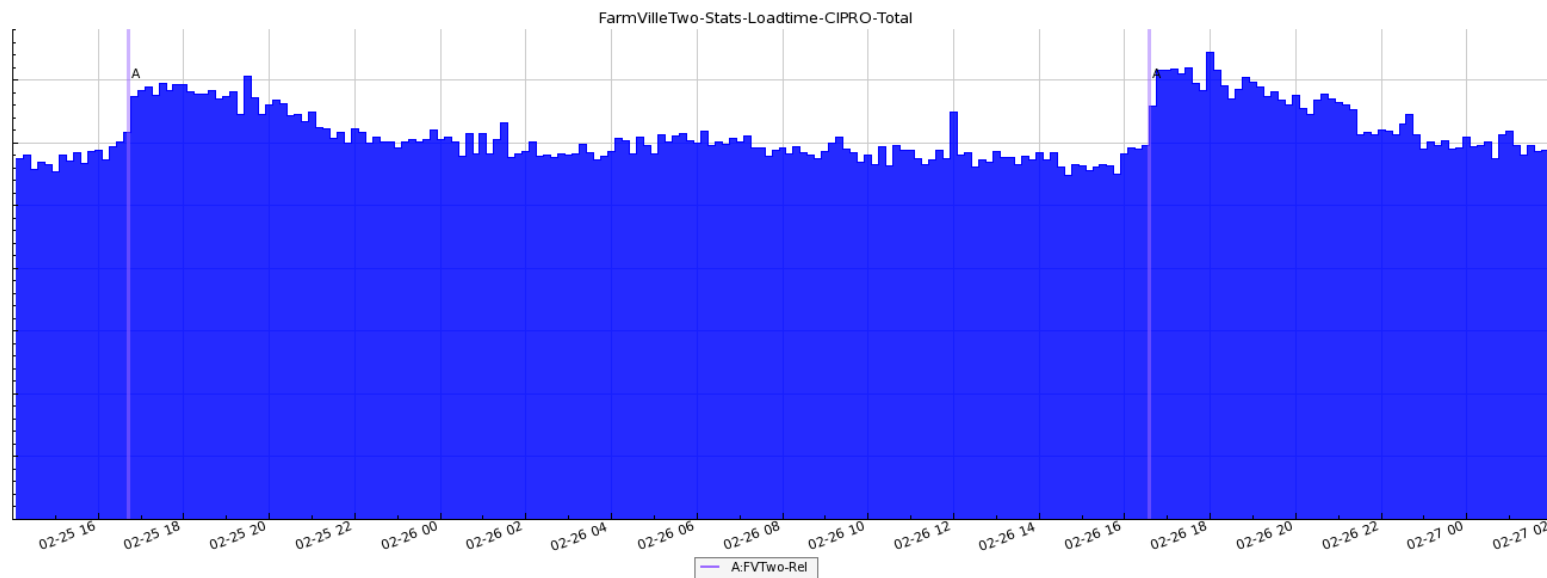
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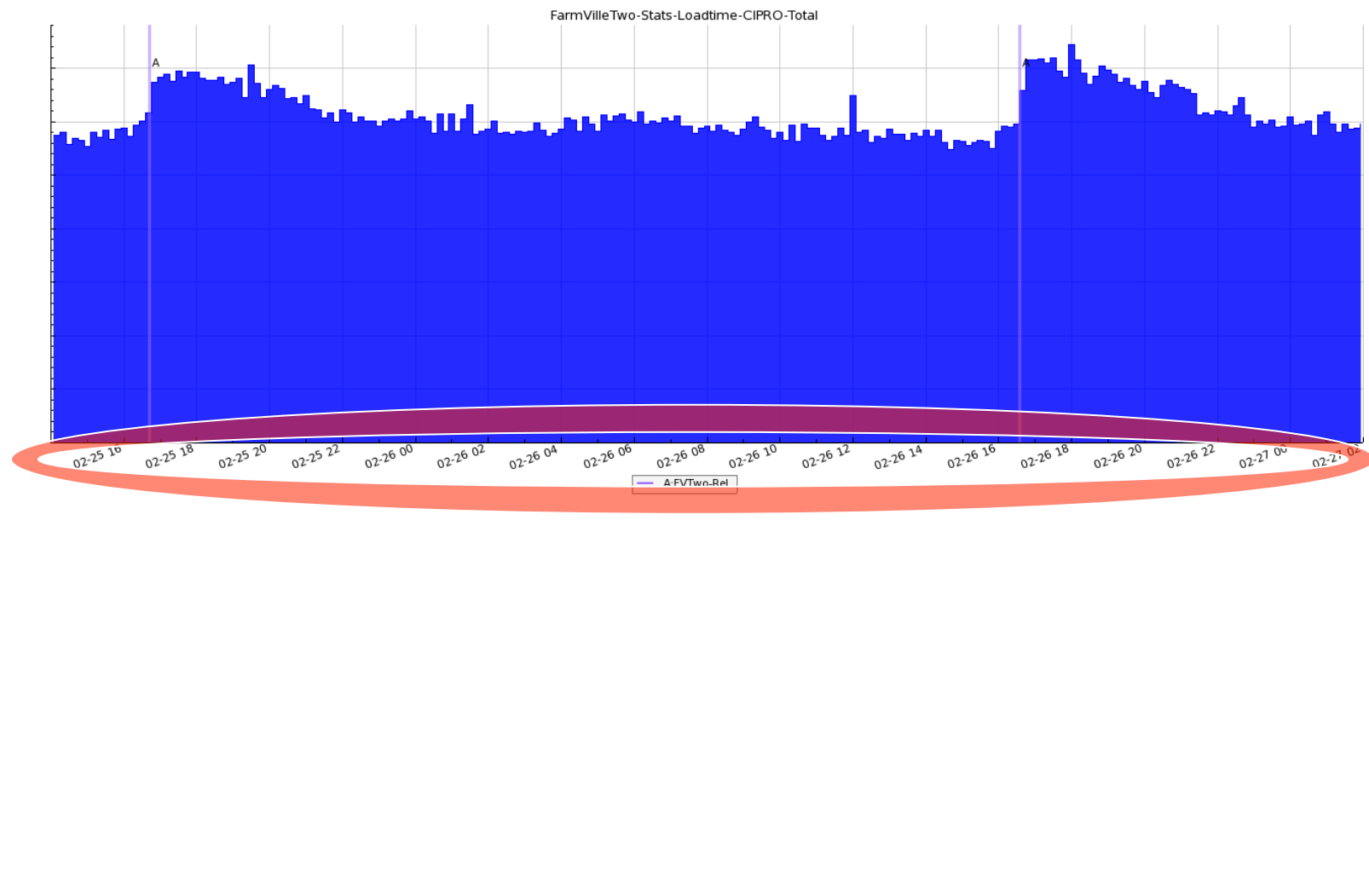
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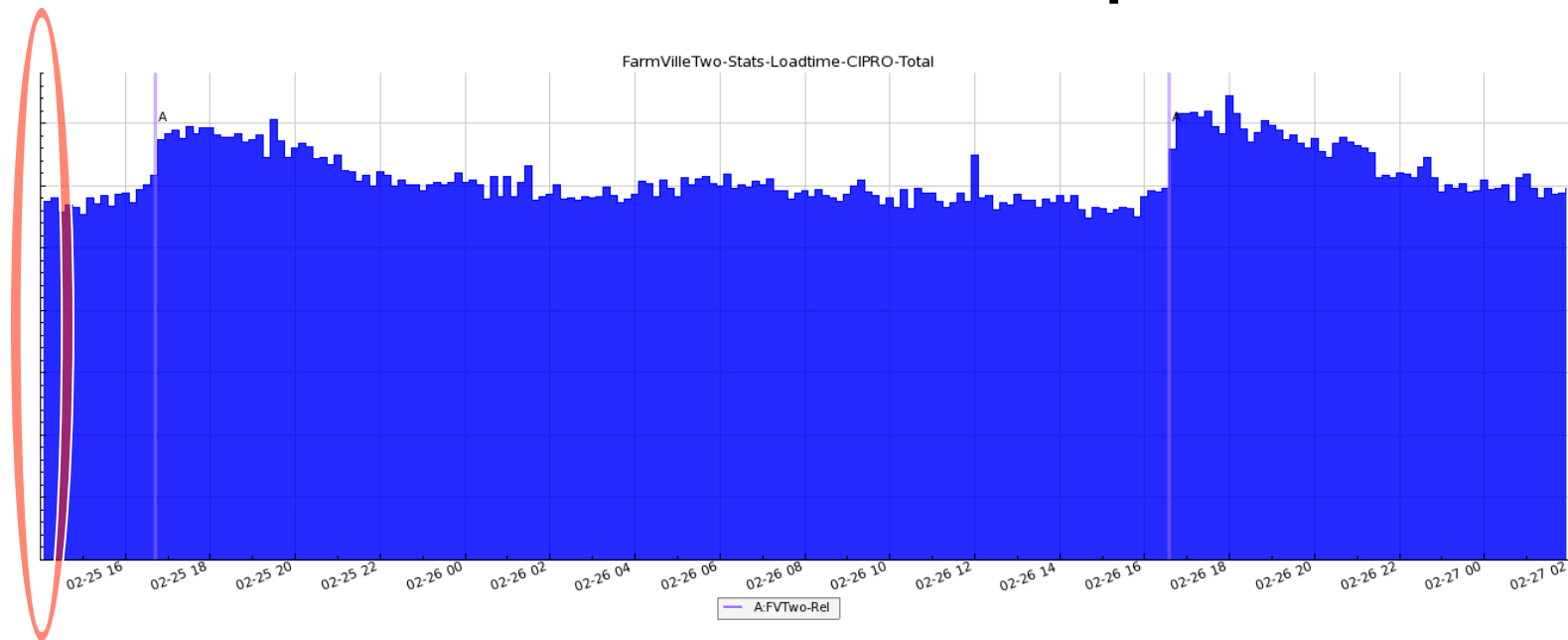
And sometimes a false positive



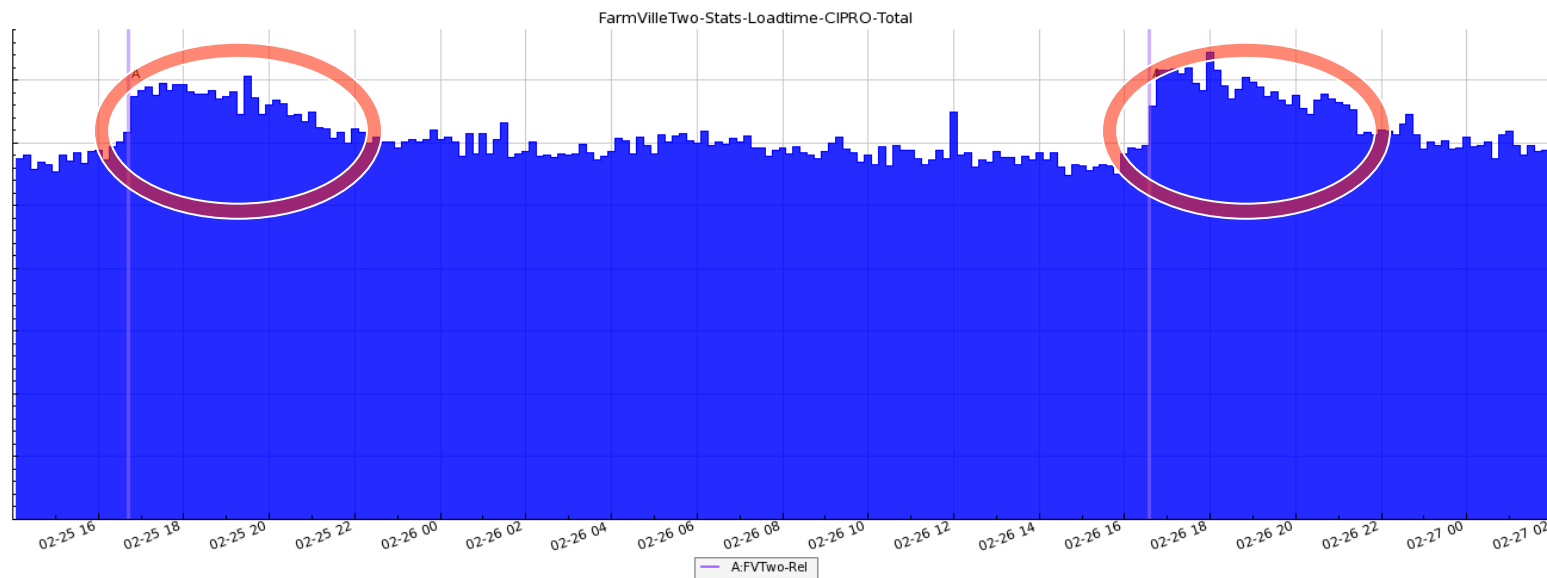
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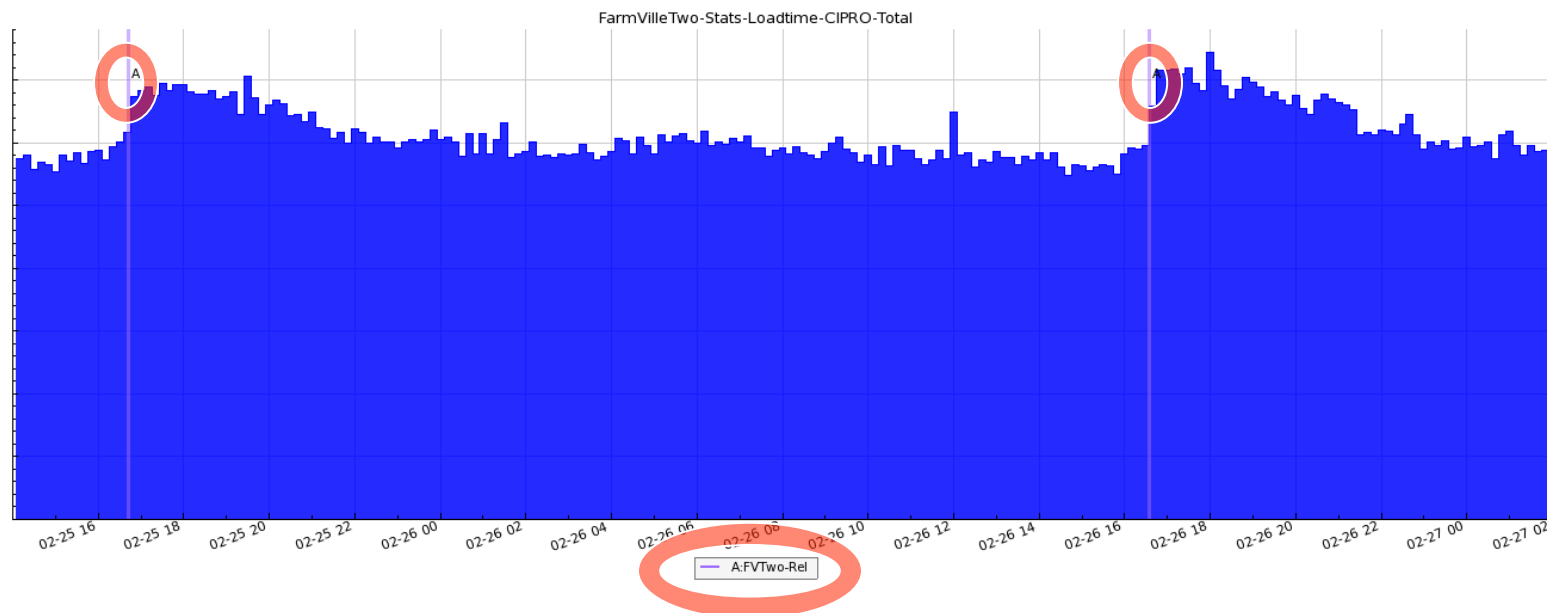
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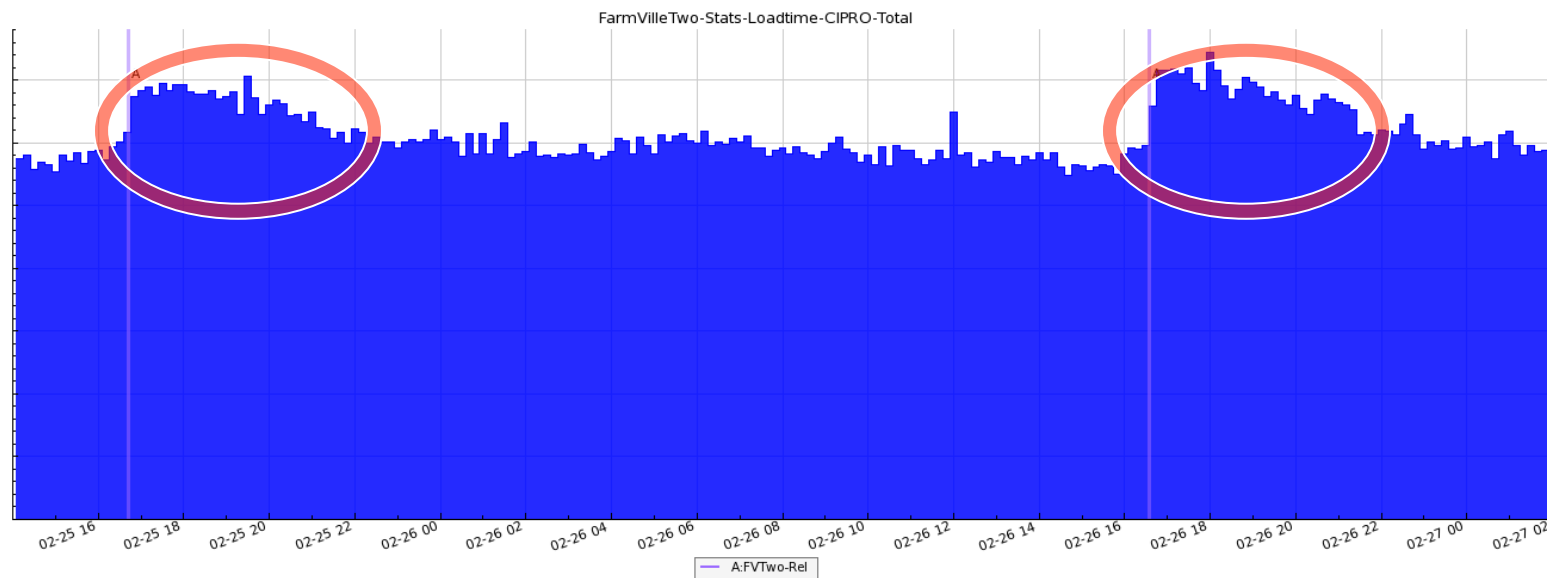
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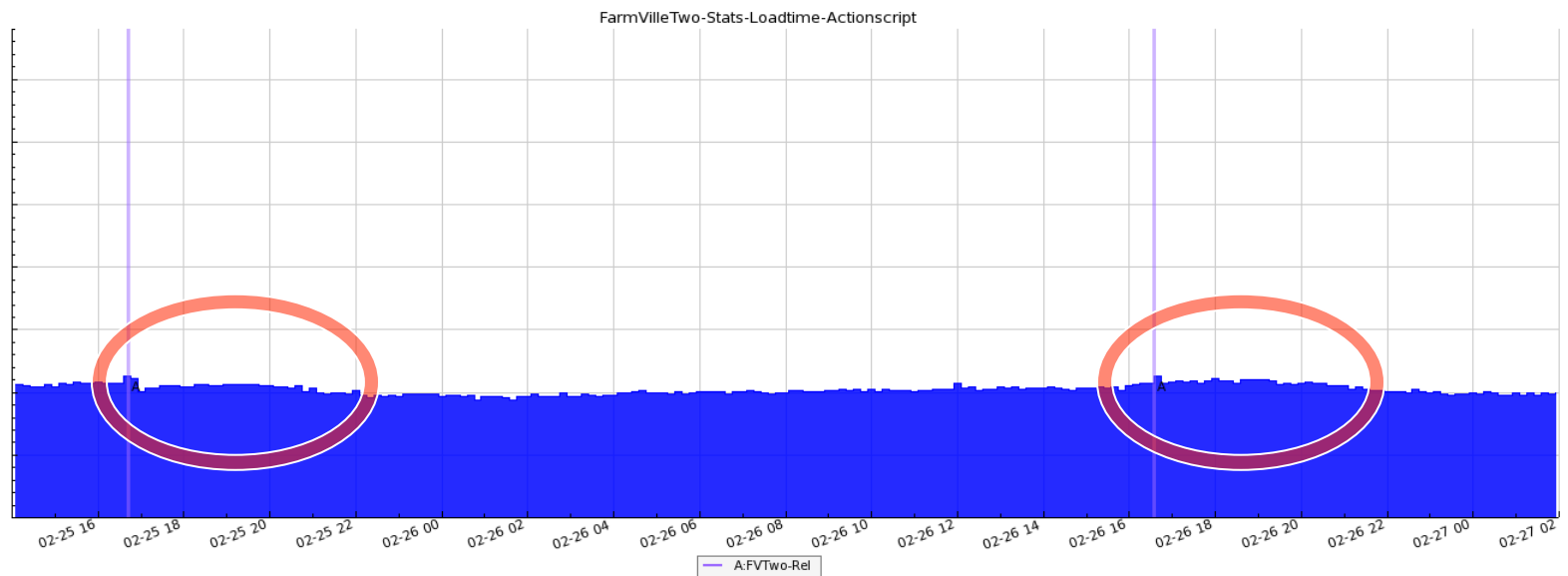
And sometimes a false positive



And sometimes a false positive



Measure the constituent parts

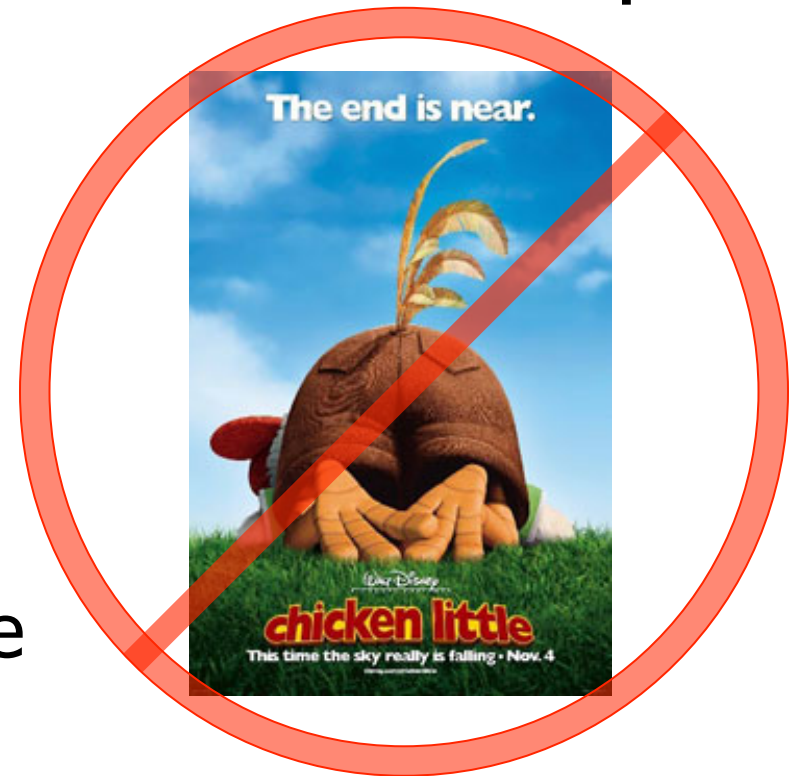


The right QA Automation can help

- Loading is easily automated under many common environmental conditions

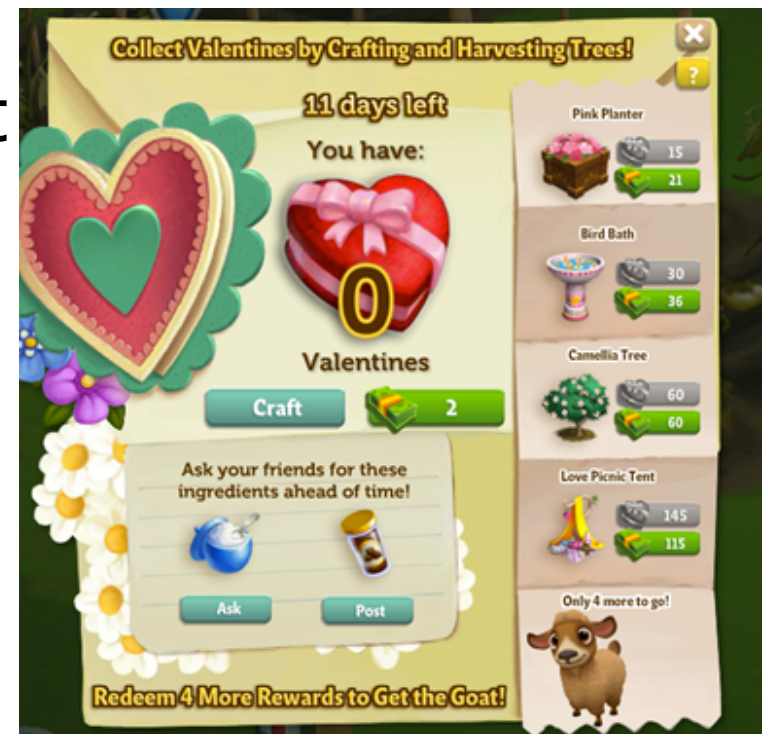
The right QA Automation can help

- Loading is easily automated under many common environmental conditions
- Measure accurate testcases, speak the same metrics, gain credibility



QA Automation is hard. Real Hard.

- Can you find a stable yet relevant benchmark for games that release every day?



Performance Regressions

- With proper data and tools, it is possible to find and fix regressions.
- If you can't stop regressions, you can't hope to improve performance.

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- What is client performance
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 - Why it's hard (revisited)

Improving Performance

- Predictably and efficiently make performance improvements.

...or lose credibility with management

Experiments are measurement tools

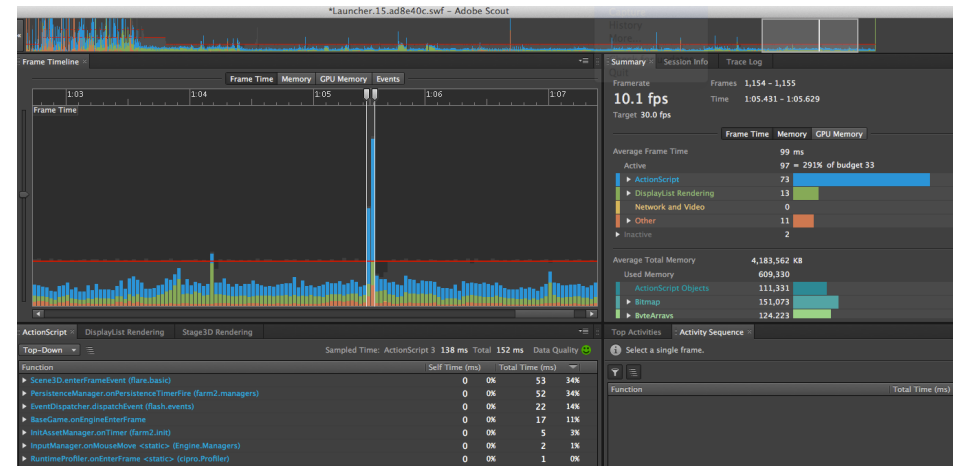


- What if there is no clear winner?

The Engineering process

- Investigate / Debug
- Hypothesize
- Implement
- Release
- Measure and Validate
- **Repeat**

Find poor performance inducing modules



Adobe Scout

Then why no impact?

1. The change wasn't an improvement

Then why no impact?

1. The change wasn't an improvement
2. The change wasn't widely significant

Then why no impact?

1. The change wasn't an improvement
2. The change wasn't widely significant
3. The change wasn't relevant anymore

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 - Why it's hard (revisited)
 - What we've done (revisited)

Measure the right time: Playtime

- 10% of sessions had no playtime at all



- Playtime can represent only 60% of the actual session time.

Production data should encourage
the same developer processes

Easily

Facilitate easy data collection for subsets of the game

- With insight into mini-games, improvement becomes possible

Facilitate easy data collection for subsets of the game

- With insight into mini-games, improvement becomes possible



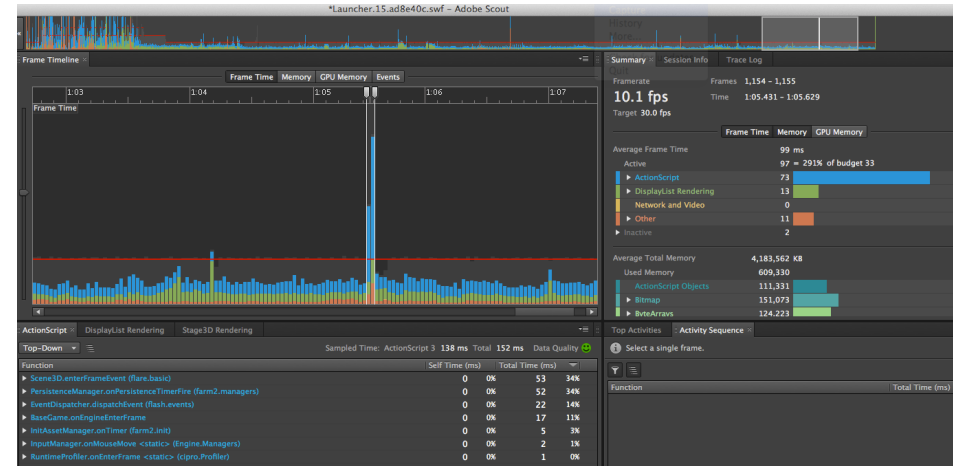
Focus on the problem to be solved

- Decompose the processing to find the slow modules.
- But only look at the sessions that you want to improve

runtimeModule	percentile_group P80 group avg_module_time
Frame	26,962.85
Actionscript	11,349.78
PrInit	9,120.79
init.execute-WorldInit	4,904.32
ResourceLoader.onComplete	3,118.50
BaseGame.onEngineEnterFrame	1,540.64
ProcessManager.onEnterFrame	1,538.72
GameWorld.createObjects	1,127.57
init.execute-GameSettingsInit	1,025.01
URLResourceLoader.OnInternalComplete	914.78
GameSettingsDownloadInit.OnConfigXmlLoaded	774.73
init.execute-GameSettingsDownloadInit	680.79

Visualize production data appropriately for the task at hand

- Frame Time = $1000 / \text{Frame Rate}$



Decompose Frame Processing

- Frame Times can be decomposed
- Fix the bad modules in the bad frames

runtimeModule	avg_bucket1_frame_time..	avg_bucket3_frame_time..
Frame	33.76	429.22
Actionscript	9.04	221.14
flare.Scene3D.enterFrameEvent	6.03	66.89
BaseGame.onEngineEnterFrame	1.86	23.56
ProcessManager.onEnterFrame	1.86	23.49
ProcessFrame.EntityManager	0.90	6.98
AssetManager.doWork	0.23	59.86
ProcessFrame.Terrain	0.44	8.30
InputManager.onMouseMove	0.48	0.89
PersistenceManager.onPersistenceTimerFire	0.07	15.73
ProcessFrame.TooltipManager	0.23	0.23
TweenLite.updateAll	0.15	4.04
ProcessFrame.JobService	0.10	1.13
flare.Flare3DLoader2.nextChunk	0.04	12.67
TimerUtil.callLater	0.00	83.91

Empower developer innovation

- Don't get in the way
- Let the developers and game code flexibly define the data that is collected
- We rely on manual instrumentation

Shared Reporting tools

- No one-off tools required
- Centralize reporting and methodologies

runtimeModule	avg_frame_time
Frame	88.27
Actionscript	41.41
flare.Scene3D.enterFrameEvent	24.71
ProcessManager.onEnterFrame	7.54
BaseGame.onEngineEnterFrame	7.52
AssetManager.doWork	3.72
flare.Scene3D.present	3.55
ProcessFrame.EntityManager	2.84
ProcessFrame.Terrain	2.77
PersistenceManager.onPersistenceTimerFire	1.43
TimerUtil.callLater	1.09
flare.Flare3DLoader2.nextChunk	0.85
InputManager.onMouseMove	0.80
ProcessFrame.JobService	0.63
InputManager.onMouseMisc	0.48
TweenLite.updateAll	0.46
ProcessFrame.TooltipManager	0.41
EntityLoadQueue.onParseMoreEntities	0.26
ProcessFrame.BlobSerializer	0.21
ProcessFrame.CountdownTimer	0.21
RuntimeProfiler.FrameProcess	0.12
MarketDialog.openDialog	0.10

Module contribution
breakdown

mode
Playtime

percentile_group
P80 group

zasp_date
3/4/2013

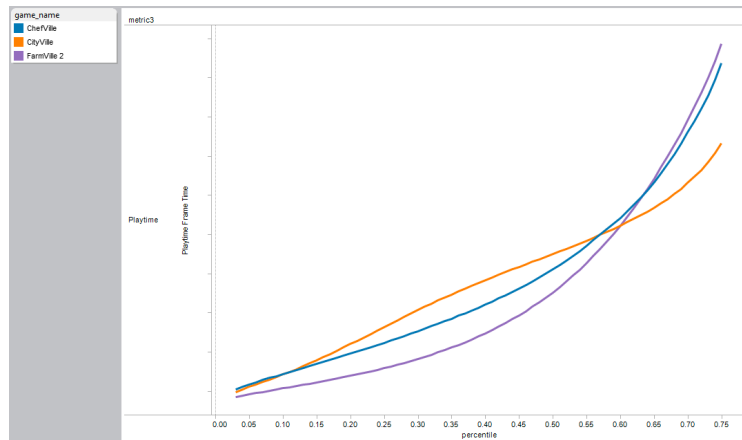
game_name
FarmVille 2

All Modules (Rows:36 Time:355.73)

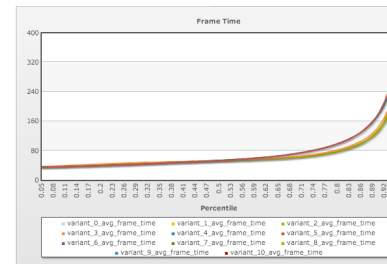
percentile_group	mode	runtimeModule	variant_0_avg_frame_time	variant_1_avg_frame_time	vc
P80 group	Playtime	Frame	93.38	97.47	
P80 group	Playtime	Actionscript	31.19	30.49	
P80 group	Playtime	Viewport.onEnterFrame	9.38	9.59	
P80 group	Playtime	BaseGame.onEngineEnterFrame	9.33	8.87	
P80 group	Playtime	BrObjectPass.draw	8.90	9.11	
P80 group	Playtime	ProcessManager.onFrame	8.85	8.36	
P80 group	Playtime	ProcessManager.onFrame	8.85	8.36	

Module contribution
breakdown by experiment

Visualization tools can guide analysis techniques



Game vs Game



All Modules (Rows 91 Time:106.68)

Mode	Percentile	variant_1_avg_frame_time	variant_2_avg_frame_time	variant_3_avg_frame_time	variant_4_avg_frame_time	variant_5_avg_frame_time	v
Playtime-Parlinactive	0.05	35.39	35.43	36.36	35.42	35.34	
Playtime-Parlinactive	0.06	35.68	35.73	36.85	35.70	35.58	
Playtime-Parlinactive	0.07	35.98	36.03	37.33	35.97	35.83	
Playtime-Parlinactive	0.08	36.27	36.34	37.84	36.22	36.08	
Playtime-Parlinactive	0.09	36.59	36.68	38.33	36.49	36.33	

By Experiment

Perf Improvements are possible

- Empower engineers to work comfortably and seamlessly with production data.

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Performance maturity is...

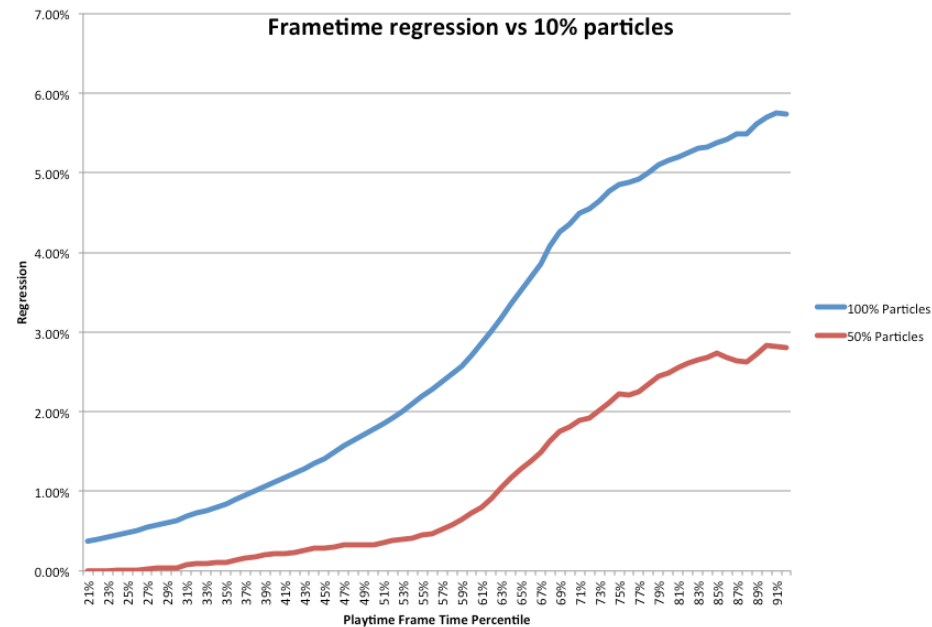
- General Manager's care.
- Engineers incorporate data from the field into their workflows.
- PM's & Designers design with an eye towards performance.

Designing with an eye to perf

- When is consuming performance worth it?



Make compromises!



“I just have to say that the snow looks great!”

There are gotchas though

Don't forget business metrics and player feedback

"Yes! It's great! The news helicopter is finally moving. All of my creepy crypts are popping their lids (in unison). My whales are jumping. Thank you very much."

"Today I have noticed that as I move around I have to wait as my city appears bit by bit."

Things to keep in mind

- Performance matters
- Your players are your workload
- Technical metrics are a tool
- The point is to make a fun and responsive game

Q & A

dgrunwald@zynga.com